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[Title Of The Invention]
SEMICONDUCTOR DEVICE

[Abstract]
PURPOSE: To attain a technology for preventing fatigue rupture at a pin joint by relaxing thermal strain even if the coefficient of thermal expansion is different between the package and the wiring board.
CONSTITUTION: In a surface mounting LSI having PGA, each of a plurality of pins taken out from the bottom face 2A of a package 2 includes a part 3A having smaller pin diameter than other part 3B and serving as a resilient strain absorbing part. The small diameter part 3A of the pin is deformed to the left or right when it is subjected to thermal strain thus absorbing the thermal strain. Since the thermal strain is relaxed and not concentrated at the tip of the pin, fatigue rupture does not take place at the pin joint.

[Claim(s)]
[Claim 1]A semiconductor device, wherein said pin has the distorted absorption part which was rich in elasticity at at least a part in a semiconductor device with which it comes to take out two or more pins from the bottom of a package.
[Claim 2]The semiconductor device according to claim 1, wherein said distorted absorption part consists of a narrow diameter portion where a pin diameter is smaller than other portions.
[Claim 3]The semiconductor device according to claim 1, wherein said distorted absorption part consists of a flection formed in a part.
[Claim 4]A semiconductor device, wherein said pin has a terminal area where a path is larger than other portions in a tip end part in a semiconductor device with which it comes to take out two or more pins from the bottom of a package.
[Claim 5]The semiconductor device according to claim 4, wherein said terminal area consists of spherical parts.
[Claim 6]The semiconductor device according to claim 4, wherein said terminal area consists of wide areas.

[Detailed Description of the Invention]
[0001]
[Industrial Application]About a semiconductor device, especially, two or more pins are taken out from the bottom of a package, and this invention is applied to the semiconductor device of the type which carries out surface mounting to a wiring board via the pin of these plurality, and relates to effective art.
[0002]
[Description of the Prior Art]The number of the leads taken out from a package tends to increase increasingly as high integration and advanced features follow the semiconductor device represented with LSI. QFP (Quad Flat Package) is known as a typical package which was adapted for such many lead-ization.

[0003]Here, since QFP has taken out two or more leads from the circumference of the package and area is occupied by the breadth of the lead in the package circumference when carrying out surface mounting of the LSI to a wiring board, it comes to receive the restrictions on mounting.
[0004]For this reason, PGA (Pin Grid Array) structure has come to be provided as a package which replaces with a lead and took out these pins from the bottom using the pin. Since two or more pins are taken out from the whole surface by the circumference of a package according to LSI which has this PGA, occupying an excessive area is lost by inserting a pin in a wiring board and mounting it.
[0005]In such PGA, PGA of what is called a surface mounting type which was made to mount in the surface has come to be developed, without forming especially a pin short and inserting these pins in a wiring board. Such PGA is also called short lead (Short lead)PGA or butt joint (Butt joint)PGA.
For example, it is indicated to the Nikkei BP issue, "VLSI packaging art (below)", May 31, 1993 issue, and P173-P174.
[0006]Since surface mounting of two or more pins is carried out to a wiring board by soldering according to LSI which has PGA of such a surface mounting type, without being inserted in a wiring board and it becomes easy to position these pins to up to a wiring board even when it becomes multi pin, it comes to be suitable for high density assembly. .
[0007]In LSI which has PGA of such a surface mounting type, as a material of a package, ceramics, a plastic, metal, etc. are used and a Fe-Ni-Co alloy, a Fe-Ni alloy, Cu, solder (Pb-Sn alloy), etc. are used as a material of a pin. Here, the path of the pin is uniformly formed in accordance with the length direction. On the other hand, bakelite, glass epoxy, paper epoxy, etc. are used as a material of a wiring board in which surface mounting of the LSI is carried out.
[0008]
[Problem(s) to be Solved by the Invention]Since the coefficients of thermal expansion of the material of a package and the material of a wiring board differ when surface mounting of the LSI which has PGA of the above surface mounting types is carried out to a wiring board, Along with the passage of time, there is a problem that the terminal area (terminal area of a pin) of the pin and wiring board which are taken out from the package does a fatigue fracture in response to a thermal strain.
[0009]That is, if heat occurs working [LSI] or ambient air temperature rises, in order for the thermal strain produced by repetition of these temperature changes based on the difference of the coefficient of thermal expansion between a package and a wiring board to concentrate on the terminal area of a pin, a terminal area comes to do a fatigue fracture. This becomes remarkable when size of a package enlarges, in order to plan high density assembly more, and it makes the reliability of the terminal area of a pin fall.
[0010]Although what is necessary is just to combine material so that the coefficient of thermal expansion of a package and a wiring board may be made to approximate in order to solve such inconvenience, since this will restrict the selection range of each material, it is not preferred. Although what is necessary is just to make the thermal strain received by restricting the area of the terminal area of a pin reduce, since it will restrict the number of pins, and this is connected with the fall of packaging density, it is not preferred.
[0011]Even if the purpose of this invention differs in the coefficient of thermal expansion of a package and a wiring board, there is in providing the art which a thermal strain is

eased and can prevent a fatigue fracture of the terminal area of a pin.
[0012]Even if other purposes of this invention differ in the coefficient of thermal expansion of a package and a wiring board, there are in providing the art which can prevent a fatigue fracture of the terminal area of a pin by increasing the area of the terminal area of a pin and reinforcing connection resilience.
[0013]The other purposes and the new feature will become clear from description and the accompanying drawing of this specification along [said] this invention.
[0014]
[Means for Solving the Problem]It will be as follows if an outline of a typical thing is briefly explained among inventions indicated in this application.
[0015](1) In a semiconductor device with which it comes to take out the bottom of a package to a pin of plurality [semiconductor device / of this invention], said pin has the distorted absorption part which was rich in elasticity at least a part.
[0016](2) In a semiconductor device with which it comes to take out the bottom of a package to two or more pins, as for a semiconductor device of this invention, said pin has a large terminal area of a path from other portions in a tip end part.
[0017]
[Function]According to the means of (1) mentioned above, the semiconductor device of this invention, In the semiconductor device which it comes to take out, two or more pins from the bottom of a package said pin, Since it has the distorted absorption part which was rich in elasticity at least the part, even if the coefficients of thermal expansion of a package and a wiring board differ, a thermal strain is eased and it becomes possible to prevent a fatigue fracture of the terminal area of a pin.
[0018]According to the means of (2) mentioned above, the semiconductor device of this invention, In the semiconductor device which it comes to take out, two or more pins from the bottom of a package said pin, Since it has a terminal area where a path is larger than other portions in the tip end part, even if the coefficients of thermal expansion of a package and a wiring board differ, it becomes possible by increasing the area of the terminal area of a pin and reinforcing connection resilience to prevent a fatigue fracture of the terminal area of a pin.
[0019]Hereafter, this invention is explained in detail with an example with reference to drawings.
[0020]In the complete diagram for describing an example, what has the same function attaches identical codes, and explanation of the repetition is omitted.
[0021]
[Example]
(Example 1) Drawing 1 is a side view showing the semiconductor device by Example 1 of this invention, and the example applied to LSI shows it. Drawing 2 is an enlarged drawing of A portion of drawing 1. Two or more pins 3 by which the end adhered by the wax material [like the bottom 2A of the package 2 to Ag wax] 4 whose semiconductor device 1 of this example is are taken out.
Each pin 3 is arranged in the shape of a grid in the direction of X, and the direction of Y.

[0022]Each pin 3 has the narrow diameter portion 3A where a pin diameter is small in the center portion in accordance with the length direction from other portions 3B which are both-ends portions. As for the material of each pin 3, a Fe-Ni-Co alloy, a Fe-Ni alloy, Cu,

solder (Pb-Sn alloy), etc. are used. Ceramics, a plastic, metal, etc. are used as a material of the package 2. The narrow diameter portion 3A of the pin 3 works as a distorted absorption part which was rich in elasticity, when surface mounting of the LSI is carried out to a wiring board by being formed so that a path may become small from other portions 3B.

[0023]Such a pin 3 is manufactured by a method as shown in drawing 3.

[0024]First, as shown in drawing 3 (a), two or more pins 3 which have a uniform path are prepared, and the photoresist 5 is applied to the Ryobe portion. This can be easily applied by dipping the both-ends portion of two or more pins 3 in the solution of the photoresist 5 by turns.

[0025]Next, as shown in drawing 3 (b), an etching process is performed by dipping two or more pins 3 in the etching solution 13 like fluoric acid and nitric acid. Of this, the narrow diameter portion 3A is formed by etching the surface where the mask of two or more pins 3 is not carried out by the photoresist 5. The portion, as for, the mask is carried out by the photoresist 5 serves as the major diameter 3B.

[0026]Then, by removing the photoresist 5 applied with an organic solvent, as shown in drawing 3 (c), after pulling up two or more pins 3 from Foto Regis's 5 solution, as shown in drawing 3 (d), two or more pins 3 separated separately are obtained.

[0027]Drawing 4 is a side view showing the structure to which the pin 3 carried out surface mounting of the LSI which has PGA of the surface mounting type pulled out from the bottom 2A of the package 2 to the wiring board 6 as mentioned above. The tip part of each pin 3 is connected to the current carrying part 7 of the wiring board 6 by the solder 8. Bakelite, glass epoxy, paper epoxy, etc. are used as a material of the wiring board 6.

[0028]According to such surface mounting structure, even if the coefficients of thermal expansion of the package 2 and the wiring board 6 differ, Since the narrow diameter portion 3A of the pin 3 is rich in elasticity even if heat occurs working [LSI], or ambient air temperature rises and a thermal strain arises based on the difference of the coefficient of thermal expansion between the package 2 and the wiring board 5, Like drawing 5, when this narrow diameter portion 3A changes into a longitudinal direction like an arrow, a thermal strain comes to be absorbed. As a result, since it is eased and a thermal strain is not concentrated on the terminal area of the tip end part of the pin 3, a fatigue fracture is not produced in the terminal area of the pin 3. Thereby, since the reliability of the terminal area of the pin 3 improves, it becomes possible to enlarge size of a package and to plan high density assembly more.

[0029]According to such an Example 1, the following effects are acquired.

[0030]Two or more pins 3 taken out from the bottom 2A of the package 2, Since it has the narrow diameter portion 3A which works as a distorted absorption part which the pin diameter was smaller than other portions 3B, and was rich in elasticity, even if the coefficients of thermal expansion of the package 2 and the wiring board 6 differ, a thermal strain is eased and it becomes possible to prevent a fatigue fracture of the terminal area of the pin 3.

[0031](Example 2) Drawing 6 is a side view showing the semiconductor device by Example 2 of this invention, and shows the example which formed the flection 9 which was rich in the center portion at elasticity as shape of the pin 3. Such a pin 3 is manufactured by a method as shown in drawing 7.

[0032]First, as are shown in drawing 7 (a) and two or more pins 3 which formed the narrow diameter portion 3A between the major diameters 3B of a both-ends portion are

shown in drawing 7 (b) after (equivalent to drawing 3 (c)) in the state where it held to one, The weight 10 of a couple is prepared and the major diameter 3B of a both-ends portion is pressed in the direction of the narrow diameter portion 3A like an arrow by each. Of this, since the narrow diameter portion 3A of a center portion changes, the flection 9 is formed. Like the narrow diameter portion 3A in Example 1, this flection 9 works as a distorted absorption part which was rich in elasticity, when surface mounting of the LSI is carried out to a wiring board.

[0033]Since the flection 9 of the pin 3 works also according to such an Example 2 as a distorted absorption part which was rich in elasticity, the same effect as Example 1 can be acquired.

[0034](Example 3) Drawing 8 is a side view showing the semiconductor device by Example 3 of this invention, and shows the example established from the both-ends portion so that a path might become small gradually toward a center portion in accordance with the length direction as shape of the pin 3. In the case of this example, the whole pin 3 comes to work as a distorted absorption part which was rich in elasticity, and the degree becomes so large that it goes to a center portion.

[0035]Since the whole pin 3 works also according to such an Example 3 as a distorted absorption part which was rich in elasticity, the same effect as Example 1 can be acquired.

[0036](Example 4) Drawing 9 is a side view showing the semiconductor device by Example 4 of this invention, and shows the example which formed the spherical part 11A in the tip end part as shape of the pin 3. When this spherical part 11A works as a terminal area when surface mounting of the LSI is carried out to a wiring board, and the path is large rather than other portions 11B, the solder 8 adheres so much.

[0037]Since the area of the terminal area of the pin 3 is increased by this, connection resilience comes to be reinforced by it. Such a pin 3 is manufactured by a method as shown in drawing 10.

[0038]That is, since it solidifies round with surface tension when the fused tip end part solidifies as are shown in drawing 10 (a), and by preparing the pin 3 which has a uniform path, and heating and fusing only this tip end part shows to drawing 10 (b), the spherical part 11A is formed.

[0039]According to such an Example 4, the following effects are acquired.

[0040]Two or more pins 3 taken out from the bottom 2A of the package 2, Since it has the spherical part 11A with a large path from other portions 11B in the tip end part, even if the coefficients of thermal expansion of the package 2 and the wiring board 6 differ, it becomes possible by increasing the area of the terminal area of the pin 3 and reinforcing connection resilience to prevent a fatigue fracture of the terminal area of the pin 3.

[0041](Example 5) Drawing 11 is a side view showing the semiconductor device by Example 5 of this invention, and shows the example which formed the wide area 12A in the tip end part as shape of the pin 3. When this wide area 12A works as a terminal area like the spherical part 11A in Example 4 when surface mounting of the LSI is carried out to a wiring board, and the path is large rather than other portions 12B, the solder 8 adheres so much. Since the area of the terminal area of the pin 3 is increased by this, connection resilience comes to be reinforced by it. This wide area 12A can be easily formed with a press working method etc.

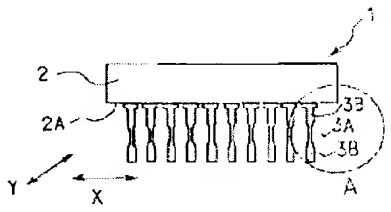
[0042]Since the solder 8 adheres so much also according to such an Example 5 when the path of the wide area 12A of the pin 3 is large rather than other portions 12B, the same

effect as Example 4 can be acquired.
[0043]As mentioned above, as for this invention, although the invention made by this invention person was concretely explained based on said example, it is needless to say for it to be able to change variously in the range which is not limited to said example and does not deviate from the gist.
[0044]For example, although said example gave and explained the example to a material specific as each material of a package, a pin, and a wiring board, not only this but an equivalent material can be used.
[0045]Although the example using a metallic material as a pin which works as a heat-absorptive part which was rich in elasticity explained in said example, materials other than metal not only like this but conductive rubber can also be used.
[0046]As shape of the pin which works as a heat-absorptive part which was rich in elasticity, forming in spring shape selectively is also possible.
[0047]Not only the shape shown in said example but various modification is possible for the shape which enlarges the path of the tip end part of a pin further again since solder is adhered so much.
[0048]Although the above explanation explained the case where it applied to the semiconductor device which has PGA of the surface mounting type which is the field of the invention which became the background about the invention mainly made by this invention person, it is not limited to it. This invention is applicable to the thing of the conditions aiming at improving a fracture of the terminal area of a pin at least.
[0049]
[Effect of the Invention]It will be as follows if the effect acquired by the typical thing among the inventions indicated in this application is explained briefly.
[0050]Even if the coefficients of thermal expansion of a package and a wiring board differ, a thermal strain is eased and it becomes possible to prevent a fatigue fracture of the terminal area of a pin.
[0051]Even if the coefficients of thermal expansion of a package and a wiring board differ, it becomes possible by increasing the area of the terminal area of a pin and reinforcing connection resilience to prevent a fatigue fracture of the terminal area of a pin.
[Brief Description of the Drawings]
[Drawing 1]It is a side view showing the semiconductor device by Example 1 of this invention.
[Drawing 2]It is an enlarged drawing of A portion of drawing 1.
[Drawing 3]The manufacturing method of the pin used for the semiconductor device by Example 1 of this invention is shown, and (a) thru/or (d) are side views.
[Drawing 4]It is a side view showing the surface mounting structure of the semiconductor device by Example 1 of this invention.
[Drawing 5]It is a side view explaining an operation of the surface mounting structure of the semiconductor device by Example 1 of this invention.
[Drawing 6]It is a side view showing the pin used for the semiconductor device by Example 2 of this invention.
[Drawing 7]The manufacturing method of the pin used for the semiconductor device by Example 2 of this invention is shown, and (a) and (b) are side views.
[Drawing 8]It is a side view showing the pin used for the semiconductor device by Example 3 of this invention.

[Drawing 9]It is a side view showing the pin used for the semiconductor device by Example 4 of this invention.
[Drawing 10]The manufacturing method of the pin used for the semiconductor device by Example 4 of this invention is shown, and (a) and (b) are side views.
[Drawing 11]It is a side view showing the pin used for the semiconductor device by Example 5 of this invention.
[Description of Notations]
1 [-- Pin,] -- A semiconductor device, 2 -- A package, 2A -- The bottom of a package, 3 3A [-- Photoresist, 6 / -- A wiring board, 7 / -- The current carrying part of a wiring board 8 / -- Solder, 9 / -- A flection, 10 / -- Weight, 11A / -- The spherical part of a pin 12A / -- The wide area of a pin 13 / -- Etching solution.] -- The narrow diameter portion of a pin, 3B -- The major diameter of a pin, 4 -- Wax material, 5

【図１】

図 1



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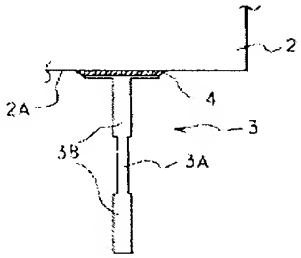

【図３】

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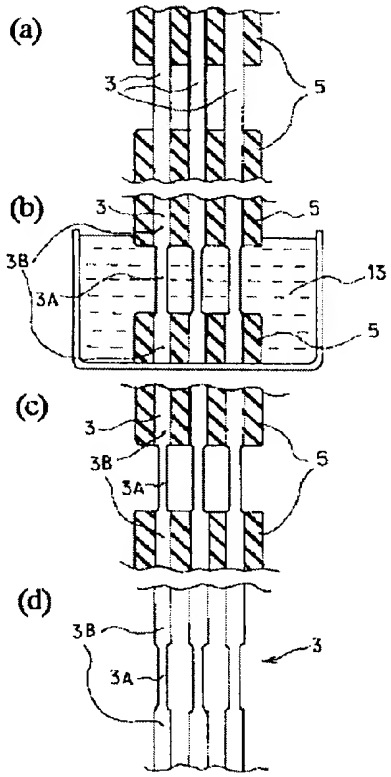

【図４】

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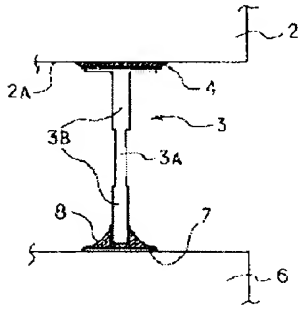
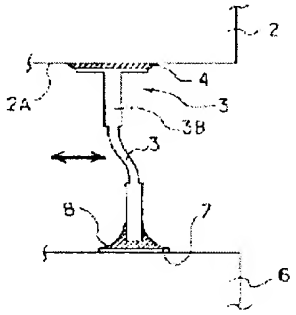


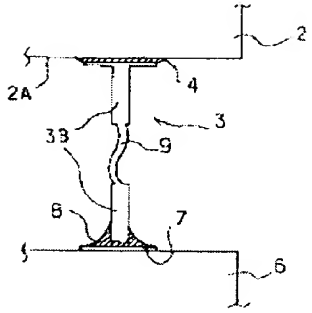
【図５】

図 5



【図６】

図６



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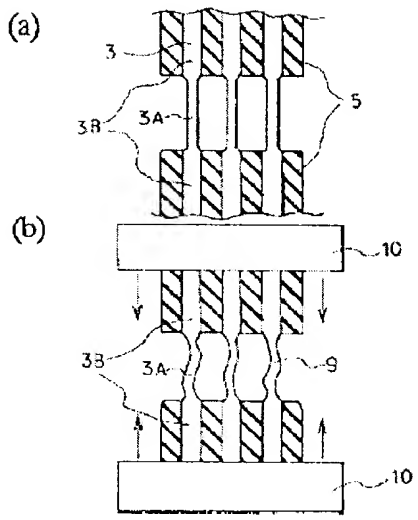
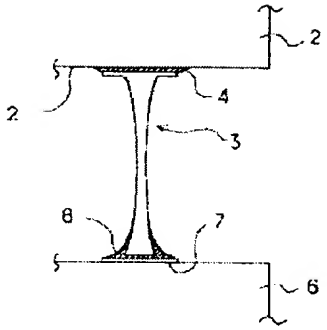


【図８】

図８



【図９】

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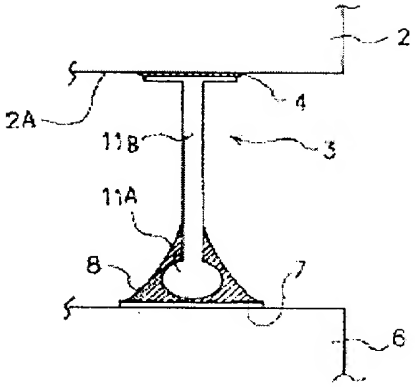
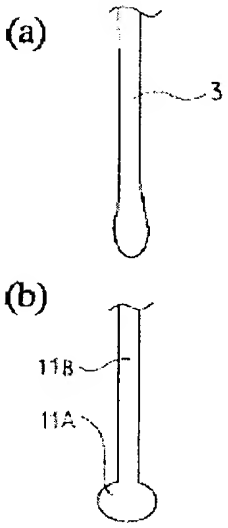


【図１０】

図１０



【図１１】

図１１